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# NEW ALGAE RECORDS (CHLOROPHYCEAE AND BACILLARIOPHYCEAE CLASSES) FROM SIX PAMPEAN LOTIC SYSTEMS OF ARGENTINA

## *NUEVOS REGISTROS DE ALGAS (CLASES CHLOROPHYCEAE Y BACILLARIOPHYCEAE) DE SEIS SISTEMAS LÓTICOS PAMPEANOS DE ARGENTINA*

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ABSTRACT

Nineteen new record species for Argentina belonged to Bacillariophyceae and Chlorophyceae Classes were identified as the result of the analysis of a total of 103 phytoplankton samples obtained from a 5-year study survey performed in 6 lotic systems from Buenos Aires province, tributaries of Río de la Plata river: Paraná de las Palmas river (1995-1996), Samborombón river, El Pescado, J. Blanco, Buñirrigo, Rodríguez and El Gato streams (1997-1998) and in a intensive study carried out in the last two systems (1999). The taxa are ilustrated, a range of physical and chemical water variables of the sampling sites in which each species was found is furnished, together with the environmental requirements, cited in the literature. The 16 % of the algae were periphytic or epilithic species, the 37 % belonged to slighty saline to brackish waters and three of them resulted pollution-tolerant species.

KEYWORDS: Chlorophyceae, Bacillariophyceae, new records, lotic systems, Argentina

RESUMEN

Diecinueve especies pertenecientes a las Clases Chlorophyceae y Bacillariophyceae, las cuales resultaron nuevas citas para Argentina, fueron identificadas como resultado del análisis de un total de 103 muestras de fitoplancton provenientes de un estudio de 5 años realizado en 6 sistemas lóticos de la provincia de Buenos Aires, tributarios del Río de la Plata: río Paraná de las Palmas (1995-1996), río Samborombón, arroyos Rodríguez, El Gato, Buñirrigo, El Pescado y J. Blanco (1997-1998) y en un estudio intensivo llevado a cabo en los dos últimos sistemas (1999). Los taxa fueron ilustrados, se provee un rango de las variables físicas y químicas del agua de los sitios de muestreo en donde cada especie se encontró, como así también sus requerimientos ambientales, citados en la literatura. El 16 % de las especies fueron perifíticas o epilíticas, el 37 % pertenecieron a aguas levemente salinas hasta salobres y 3 de ellas resultaron especies tolerantes a la polución.

PALABRAS CLAVE: Chlorophyceae, Bacillariophyceae, nuevos registros, sistemas lóticos, Argentina.

## INTRODUCTION

Several investigations have been performed in the NE of Buenos Aires province (Argentina), dealing with the phytoplankton taxonomy of lotic systems, tributaries of Río de la Plata river, such as Reconquista river (Alberghina & Loez 1991), Luján river (Vinocur & Tell 1989; Tell & Vinocur 1991), and the Matanza-Riachuelo system (Conforti 1991) whereas there are no publications on this subject refered to other rivers and streams of this province.

This article is a contribution to a series of papers dealing with the phytoplankton of tributaries of the Río de la Plata river (Mercado & Gómez 1998 a; Mercado & Gómez 1998 b; Mercado & Gómez 2000 and Mercado 2001). The previous papers were focused on the phytoplankton structure of these lotic systems. More recently, my studies also included the

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taxonomy aspect of these communities.

In this paper, nineteen new record species for Argentina belonged to Bacillariophyceae and Chlorophyceae Classes were identified, among other algae, as the result of the analysis of a total of 103 phytoplankton samples obtained from a 5-year study survey performed in 6 lotic systems from Buenos Aires province, tributaries of Río de la Plata river: Paraná de las Palmas river (1995-1996), Samborombón river, El Pescado, J. Blanco, Buñirrigo, Rodríguez and El Gato streams (1997-1998), and in a intensive study carried out in the last two systems (1999). All taxa are ilustrated, a range of physical and chemical water variables of the sampling sites in which each species was found is furnished, together with the environmental requirements, cited in the literature.

## STUDY AREA

The Paraná river basin is the second largest hydrographic system in South America after that of the Amazon river, with an area of $3.10^6$ km$^2$ and roughly 4000 km of length (Fig. 1a). The lower section of the Paraná river extends downstream the latitude 32° 05' S. Upstream Zárate City (Buenos Aires province) the river divides in two main arms, the Paraná de las Palmas and the Paraná Guazú, which delimits a vast delta of around 15,000 km$^2$ (Fig. 1b). The intense agricultural activity developed in the margins of Paraná de las Palmas river, the industries (meat, leather, metallurgic and petrochemical processing plants) and large cities without sewage treatment (up to 2 millon inhabitants) situated downstream

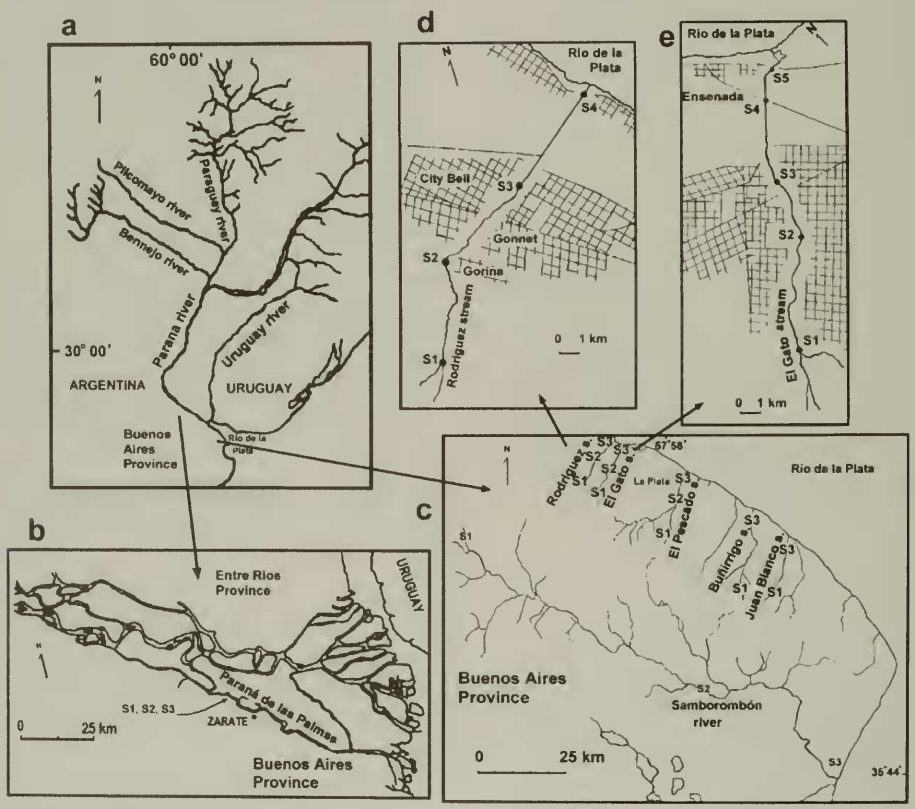


FIG. 1: a-e. 1a. Location of Paraná river basin and Buenos Aires province; 1b. Paraná de las Palmas river; 1c. Location of Rodríguez, El Gato, El Pescado, J. Blanco, Buñirrigo streams and Samborombón river; 1d. Rodríguez stream basin; 1e. El Gato stream basin.

Santa Fe city (31° 36' S – 60° 43' W), produce an important anthropogenic impact over this system (Mercado & Gómez 1999, 2000).

Samborombón river, El Pescado, J. Blanco, Rodríguez and El Gato streams are also tributaries of Río de la Plata river (Fig. 1c). They are located in the NE of Buenos Aires province. The headwaters of these streams are analogous to shallow lentic systems, due to their low depth and current velocity. These variables increase considerably in their mouths. The middle and lower sections of Samborombón river are affected by industrial and extensive agricultural activities (Mercado 1999, 2000 a, 2000b). Run-off water of mainly intensive agricultural activities drain to El Pescado Stream; Juan Blanco stream is practically not affected by human impact because it is situated in 'Parque Costero del Sur' UNESCO reservation (Mercado 1999, 2000a, 2000b). Rodríguez and El Gato streams (Fig. 1c, 1d, 1e) are seriously impacted by human activities: they receive sewage water from Gorina, Gonnet and City Bell cities (Rodríguez stream), Ensenada and the west section of La Plata city (El Gato stream), along with industrial efluents (Mercado 1999, 2000a, 2000b, 2000c, 2000d).

## MATERIAL AND METHODS

Samples from Paraná de las Palmas river were taken every 45 days from March 1995 to August 1996 (D1 to D11; D = Date) at three sampling stations situated between km 133 and km 136 (S1 to S3) (Fig. 1b). Samborombón river, El Pescado, J. Blanco, Rodríguez and El Gato streams were sampled seasonally during 1997-1998. Surveys were carried out in Autumn 1997 (D1), Winter (D2), Spring (D3), Summer 1998 (D4) and Autumn (D5). Sample sites were situated in 2 or 3 stations from the headwaters (S1) to the mouths (S3) in each system (Fig. 1c). El Gato and Rodríguez streams were sampled in 1999 during a high-water (Winter, D6) and a low-water period (Spring, D7). Four stations were selected in the first one (S1 to S4) and five in the latter (S1 to S5), situated from the headwaters to the mouth (Fig. 1d, 1e, respectively).

Methodology used to take in situ water measurements (temperature, dissolved oxygen, pH, conductivity and transparency) and to determine suspended matter, nutrients and macroions is described in Mercado & Gómez (2000) and Mercado (1999, 2000a, 2000b, 2000c, 2000d).

Samples for phytoplankton qualitative analysis were obtained with plankton nets of 15 and 25 µm mesh and fixed in formol 4 %. Taxonomic analysis was performed by using an Olympus BHA microscope with phase contrast. Samples were deposited in the herbarium of the 'Instituto de Limnología Dr. R.A. Ringuelet'.

Organic matter contained by the diatoms was eliminated according to the methodology proposed by Barber & Haworth (1981). Afterwards, frustules were mounted in Naphrax.

Taxonomic identifications were performed following Hustedt (1930), Krammer & Lange-Bertalot (1986, 1988, 1991 a ,b), Patrick & Reimer (1966, 1975), Komárek & Fott (1983). Simonsen's (1979) systematic arrangement, Vanlandingham (1967-1979) valid names of the diatom species identified and recent papers were considered. A range of physical and chemical water variables of the sampling sites in which each species was found is included, together with their environmental requirements, cited in the literature. The catalogue of freshwater algae of Argentina (Tell 1985), the update unpublished catalogue (Tell, m.s) and latest papers were considered to identify new records for Argentina.

Four categories of species were stablished, by means of the frequency and the contribution percentage of each species: dominant, abundant, frequent and rare. The identification of these categories was performed using these criteries: a) dominant species: those with densities superior to 50% of the total density of the sample, b) abundant species: those with densities comprised between 5-50% of the total density, c) frequent species: those which were presented in each sample in a proportion lower than 5 %, d) rare species: those which were registered in a unique sample, when each system and each date were considered.

## RESULTS

### CHLOROPHYCEAE

Chlorococcales

Fam. Dictyosphaeriaceae

***Dictyosphaerium*** Näg.

***Dictyosphaerium subsolitarium*** Van Goor

Pl. I, fig. 1

Dimensions: Colonies 15-33 µm diam.; cells 2.5-

3.5 µm diam.
Occurrence: Paraná de las Palmas river (D1; S2), El Gato stream (D4; S2, S3), El Pescado stream (D4; S1).
Frecuency: Frequent species.
Environmental requirements: In plankton of eutrophic environments (Komarek & Fott 1983). This species was found in Summer and Fall in systems with a wide range of conductivity, nutrients and oxygen concentrations (Table I); El Gato stream is considered a polluted system (Mercado 1999, 2000a, 2000b, 2000c).
Observation: Certain cells were larger than the typical species (1.5-3.0 µm diam.) described in Komarek & Fott (1983).

TABLE I: Ranges of the physical and chemical variables of the sampling sites in which the 19 species were found.

| Especie | T | $O_2$ | pH | Cond. | $NH_4^+$ | $NO_3^-$ | $NO_2^-$ | PRS | SS |
|---|---|---|---|---|---|---|---|---|---|
| *Dictyosphaerium subsolitarium* | 14.4-26.0 | 0.2-6.0 | 7.3-8.4 | 123-1354 | 10-16179 | 26-785 | 7-29 | 37-1121 | 35.0-88.3 |
| *Monoraphidium subclavatum* | 21.0-25.6 | 6.0-7.5 | 7.8-8.8 | 612-1030 | 47-196 | 20-170 | 13-15 | 55-76 | 33.0-184.1 |
| *Scenedesmus apiculatus* | 15.0-25.0 | 0.6-4.2 | 8.0-8.6 | 299-854 | 6534-9639 | 2537-6310 | 658-818 | 2386-4165 | 59.0-85.0 |
| *S. ecornis var. polymorphus* | 14,0 | 3,6 | 7,5 | 653 | 2712 | 2159 | 62 | 2090 | 110,8 |
| *Achnanthes delicatula* | 21.0-35.0 | 6.0-14.3 | 8.4-8.7 | 432-1085 | 93-4033 | 19-25 | 19-365 | 182-8923 | 29.0-68.0 |
| *A. oblongella* | 13,0 | 7,7 | 6,7 | 235 | 295 | 916 | 55 | 737 | 292,0 |
| *Eunotia triodon* | 25,6 | 7,5 | 8,8 | 1030 | 196 | 20 | 13 | 76 | 33,0 |
| *Amphora libyca* | 17.5-27.1 | 5.0-7.8 | 7.3-8.9 | 121-1900 | 8-606 | 11-555 | 7-34 | 39-432 | 37.0-671.0 |
| *Diploneis oculata* | 19,5 | 7,0 | 8,3 | 2000 | 462 | 47 | 21 | 84 | 225,0 |
| *Navicula goeppertiana* | 15.4-24 | 6.0-8.0 | 8.3-9.1 | 262-2000 | 86-462 | 37-47 | 4-34 | 84-364 | 76.0-1119.0 |
| *Hantzschia virgata* | 11.0-20.0 | 2.7-9.7 | 6.4-8.4 | 101-4400 | 21-45900 | 5-2941 | 22-785 | 77-6921 | 71.0-216.0 |
| *Nitzschia angustata* | 23,2 | 3,9 | 7,6 | 1404 | 8582 | 600 | 15 | 658 | 43,0 |
| *N. amphiboides* | 15.0-25.6 | 4.0-9.0 | 7.5-9.4 | 185-1030 | 12-6755 | 1-1843 | 3-123 | 2-3818 | 33.0-113.0 |
| *N. claussii* | 11.0-23.2 | 3.9-10.2 | 6.4-7.6 | 101-1414 | 59-8582 | 401-802 | 15-31 | 658-701 | 43.0-252.0 |
| *N. terrestis* | 23,2 | 3,9 | 7,6 | 1404 | 8582 | 600 | 15 | 658 | 43,0 |
| *N. filiformis f. conferta* | 11.0-15.4 | 3.9-6.7 | 7.6-9.1 | 600-1404 | 110-8582 | 37-600 | 15-34 | 50-658 | 43.0-1119.0 |
| *N. obtusa* | 27,1 | 7,8 | 8,9 | 1900 | 446 | 11 | 7 | 95 | 418,0 |
| *N. heufleriana* | 27,0 | 11,7 | 8,4 | 1345 | 1015 | 698 | 514 | 895 | 30,0 |
| *N. spectabilis* | 19,5 | 7,0 | 8,3 | 2000 | 462 | 47 | 21 | 84 | 225,4 |

| Especie | $CO_3^-$ | $HCO_3^-$ | $Ca^{2+}$ | $Mg^{2+}$ | $Na^+$ | $K^+$ | $SO_4^{2-}$ | $Cl^-$ |
|---|---|---|---|---|---|---|---|---|
| *Dictyosphaerium subsolitarium* | 0-4.3 | 12.5-104.5 | 6.4-29.7 | 3.9-17.7 | 15.2-153.4 | 2.8-17.6 | 4.0-105.1 | 10.8-71.0 |
| *Monoraphidium subclavatum* | 0-11.4 | 45.9-67.2 | 17.6-21.7 | 1.6-13.7 | 107.5-143.0 | 7.2-8.1 | 44.6-64.7 | 56.0-125.1 |
| *Scenedesmus apiculatus* | 0 | 39.1-168.1 | 8.0-10.4 | 2.9-15.2 | 40.0-103.4 | 9.5-32.0 | 25.5-28.6 | 30.0-67.0 |
| *S. ecornis var. polymorphus* | 0 | 98,8 | 16,8 | 31,3 | 96,2 | 18,0 | 76,1 | 46,0 |
| *Achnanthes delicatula* | 4.3-37.7 | 31.9-432.6 | 12.2-36.3 | 8.0-9.7 | 82.0-151.0 | 10.0-35.2 | 33.5-55.7 | 33.6-104.9 |
| *A. oblongella* | 0 | 98,7 | 15,0 | 30,3 | 36,7 | 13,6 | 20,0 | 14,0 |
| *Eunotia triodon* | 11,4 | 45,9 | 21,7 | 13,7 | 143,0 | 8,1 | 64,7 | 125,1 |
| *Amphora libyca* | 0-26.7 | 24.5-71.6 | 5.7-22.8 | 1.9-49.1 | 15.7-272.8 | 2.7-19.5 | 4.0-86.5 | 10.5-400.4 |
| *Diploneis oculata* | 5,7 | 17,4 | 12,0 | 34,4 | 220,2 | 20,0 | 178,8 | 70,4 |
| *Navicula goeppertiana* | 4.3-25.0 | 17.4-284.0 | 12.0-16.0 | 4.0-34.4 | 75.5-220.2 | 13.5-28.0 | 22.3-178.8 | 12.0-70.4 |
| *Hantzschia virgata* | 0-20.0 | 20.3-378.0 | 6.7-30.0 | 6.0-23.4 | 7.2-139.8 | 9.8-31.0 | 0.7-103.8 | 4.0-56.4 |
| *Nitzschia angustata* | 0,0 | 487,8 | 16,0 | 5,5 | 160,5 | 17,8 | 66,5 | 190,2 |
| *N. amphiboides* | 0-11.4 | 21.9-97.0 | 13.7-21.7 | 1.9-15.0 | 16.5-143.0 | 2.7-14.4 | 10.9-64.7 | 18.0-125.1 |
| *N. claussii* | 0,0 | 52.3-487.8 | 6.5-16.0 | 5.5-20.3 | 7.2-160.5 | 11.2-17.8 | 0.7-66.5 | 4.0-190.2 |
| *N. terrestis* | 0,0 | 487,8 | 16,0 | 5,5 | 160,5 | 17,8 | 66,5 | 190,2 |
| *N. filiformis f. conferta* | 0-25 | 39.2-487.8 | 16.0-24.1 | 1.5-4.0 | 62.0-160.5 | 4.5-28.0 | 22.3-66.5 | 42.0-190.2 |
| *N. obtusa* | 26,7 | 24,6 | 20,9 | 49,2 | 272,8 | 19,6 | 86,5 | 400,4 |
| *N. heufleriana* | 34,8 | 438,4 | 13,1 | 6,6 | 173,9 | 15,7 | 49,1 | 160,2 |
| *N. spectabilis* | 5,7 | 17,4 | 12,0 | 34,4 | 220,2 | 20,0 | 178,8 | 70,4 |

Fam. Oocystaceae
***Monoraphidium*** Kom. - Legn.

***Monoraphidium subclavatum*** Nyg.
Pl. I, fig. 2
Dimensions: Cells 12-20 µm long, 2.5-3.0 µm broad.
Occurrence: J. Blanco stream (D1; S3), Samborombón river (D3, S1).
Frequency: Frequent species.
Environmental requirements: In eutrophic environments (Komarek & Fott 1983). This species was found in Fall and Spring in systems with moderate conductivity, low suspended solids and nutrient concentrations, such as El Blanco stream, which registered low human impact (Mercado 1999, 2000a, 2000b) and in Samborombón river, with higher suspended solids, nutrient concentrations and conductivity, specially due to $Na^+$ and $Cl^-$ (Table I).

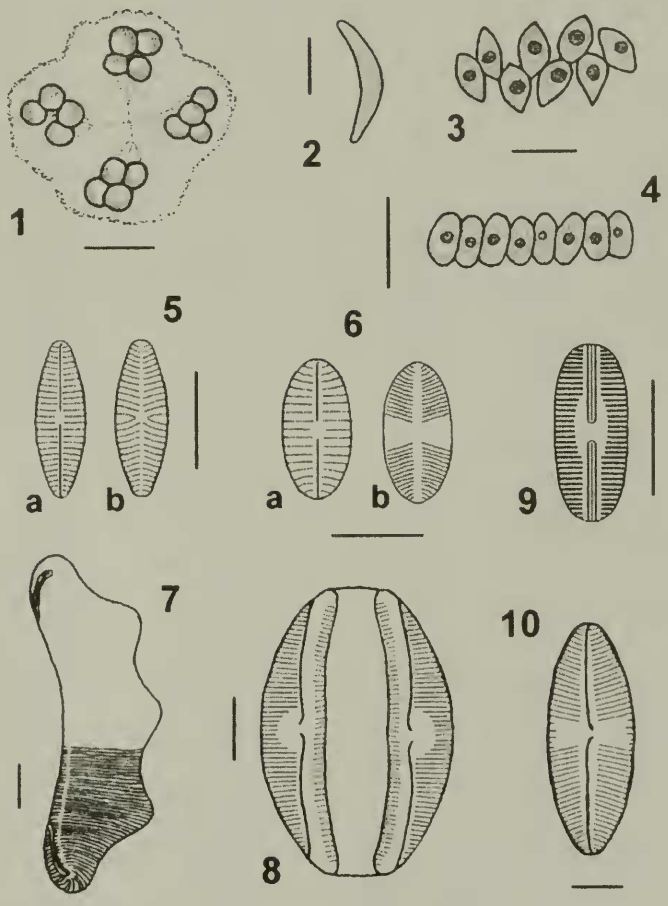


Plate I. Chorophyceae and Bacillariophyceae new records algae for Argentina. 1. *Dictyosphaerium subsolitarium* Van Goor 2. *Monoraphidium subclavatum* Nyg. 3. *Scenedesmus apiculatus* (W. & G.S. West) Chod. 4. S. *ecornis v. polymorphus* Chod. 5. *Achnanthes delicatula* Kütz. a. Raphe valve b. Rapheless valve 6. *A. oblongella* Oestrup a. Raphe valve b. Rapheless valve 7. *Eunotia triodon* Ehr. 8. *Amphora libyca* Ehr. 9. *Diploneiss oculata* (Bréb) Cléve 10. *Navicula goeppertiana* (Bleisch) Grun. The scale represents 10 µ.

Fam. Scenedesmaceae
***Scenedesmus*** Meyen

*Scenedesmus apiculatus* (W. & G.S. West) Chod.
Pl. I, fig. 3
Dimensions: Cells 8-12 µm long, 6-8 µm broad.
Occurrence: Rodríguez stream (D3; S2), El Gato stream (D2; S3).
Frequency: Rare species.
Environmental requirements: This species was found in Winter and Spring in systems with low oxygen concentrations, moderate conductivity and high nutrients concentrations. Rodríguez and El Gato streams are considered as polluted systems in Mercado (1999, 2000a, 2000b, 2000c, 2000d), specially from the middle sections to their mouths.

***Scenedesmus ecornis v. polymorphus*** Chod.
Pl. I, fig. 4
Dimensions: Cells 5-8 µm long, 3.0-5.5 µm broad
Occurrence: Rodríguez stream (D1, S2).
Frequency: Rare species.
Environmental requirements: This species was found in Fall in S2 of Rodríguez stream, which registered low oxygen concentration and high nutrient and suspended solids concentrations.

BACILLARIOPHYCEAE
Pennales
Fam. Achnanthaceae
***Achnanthes*** Bory

***Achnanthes delicatula*** Kütz.
Pl. I, fig. 5
Dimensions: 14-17 µm long.; 6-8 µm broad; striae 14-15 in 10 µm.
Occurrence: El Pescado stream (D4; S3), El Gato stream (D7, S1).
Frequency: Rare species.
Environmental requirements: In slighty saline waters, rare in freshwater (Hustedt 1930). Present especially in brackish waters (CEMAGREF 1999). Euryhaline species (Germain 1981). This species was found in Spring and Summer in systems with a wide range of conductivity, nutrients, oxygen and macroions concentrations.

***Achnanthes oblongella*** Oestrup
Pl. I, fig. 6
Dimensions: 10-14 µm long.; 5.5-7.5 µm broad; striae 12-13 in 10 µm (RV) and 23-25 (RLV).
Occurrence: Rodríguez stream (D6; S4).
Frequency: Rare species.
Environmental requirements: This species was found in Winter, during a rainy period, in S4 of Rodríguez stream, which presented at that moment a relatively acid pH (6.7), low conductivity, moderate nutrients concentrations and high suspended solids concentration (Table I).

Fam. Eunotiaceae
***Eunotia*** Ehr.

***Eunotia triodon*** Ehr.
Pl. I, fig. 7
Dimensions: 42-60 µm long.; 15-21 µm broad; striae 14-16 in 10 µm.
Occurrence: Samborombón river (D3, S1).
Frequency: Rare species.
Environmental requirements: Prefers oligotrophic to somewhat acid waters (Patrick & Reimer 1966). This species was found in Spring, in the headwaters of Samborombón river, a site with high conductivity, specially due to $Na^+$ and $Cl^-$ ions, and relatively low nutrient concentrations (Table I).

Fam. Naviculaceae
***Amphora*** Ehr.

***Amphora libyc***a Ehr.
Pl. I, fig. 8
Dimensions: 30.0-70.5 µm long.; 14-30 µm broad; striae 12-15 in 10 µm.
Occurrence: Paraná de las Palmas river (D1, S1), El Pescado stream (D1, S3; D3, S2), Samborombón river (D3, S3).
Frequency: Frequent species.
Environmental requirements: Ubiquitous species (CEMAGREF 1999). This species was found in Fall and Spring, in systems with a wide range of pH, conductivity, nutrients and suspended solids concentrations (Table I).

***Diploneiss*** Ehr.

***Diploneiss oculata*** (Bréb.) Cleve
Pl. I, fig. 9
Dimensions: 15-17 µm long.; 6.0-7.5 µm broad; striae 22-23 in 10 µm.
Occurrence: Samborombón river (D4, S3).
Frequent: Rare species.

Environmental requirements: Epilithic rare species, ocassionally present in streams (Germain 1981). In freshwater of variable mineral content (Patrick & Reimer 1966). This species was found in Summer; in the mouth of Samborombón river, a site with a basic pH (8.3), high conductivity, suspended solids and $NH_4^+$ concentration (Table I).

*Navicula* Bory

***Navicula goeppertiana*** (Bleisch) Grun.
Pl. I, fig. 10
Dimensions: 20-50 µm long.; 8-15 µm broad; striae 9-10 in 10 µm.

Occurrence: Rodríguez stream (D2, S1), Samborombón river (D4, S3), El Pescado stream (D4, S2).
Frequency: Rare species.
Environmental requirements: It is a very abundant species in streams; it is a pollution-tolerant species, abundant e.g. in efluents of milky industries (Germain 1981). This species was found in Winter and Summer, in systems with a wide range of conductivity, suspended solids, nutrients and macroions concentrations. Rodríguez stream is considered a polluted system in Mercado (1999, 2000a, 2000b, 2000d), specially from the middle sections to their mouths.

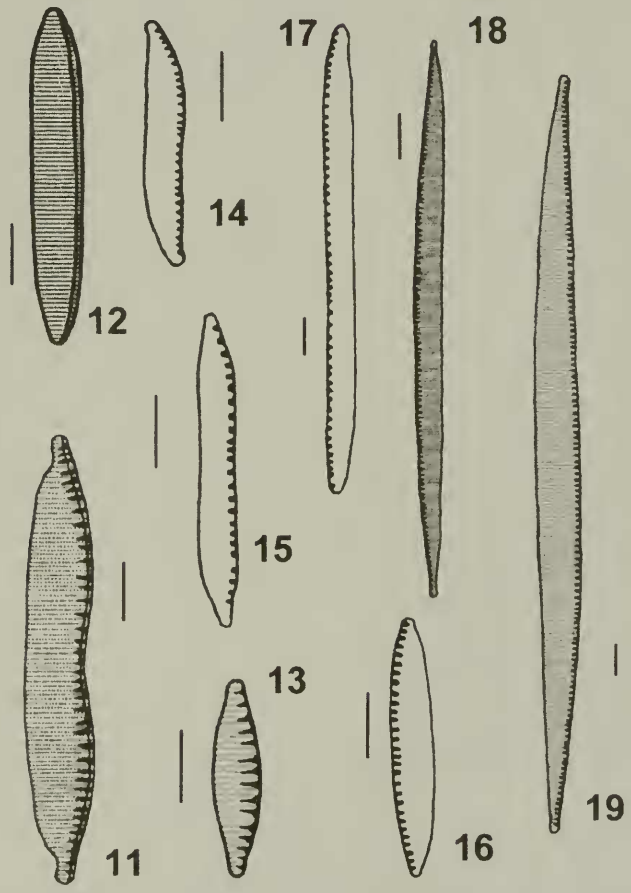


Plate II. Bacillariophyceae new records algae for Argentina. 11. *Hantzschia virgata* (Roper) Grun. 12. *Nitzschia angustata* (W.Sm.) Grun. 13. *N. amphiboides* Hust. 14. N. *clausii* Hantzsh.15. *N. terrestris* (Petersen) Hustedt 16. *N. filiformis v. conferta* (Reichter) Lange-bertalot 17. *N. obtusa* W. Smith 18. *N. heufleriana* Grun. 19. N. spectabilis (Ehr.) Ralfs. The scale represents 10 µ.

*Hantschia* Grun.

*Hantzschia virgata* (Roper) Grun.
Pl. II, fig. 11
Dimensions: 70-110 µm long.; 8-13 µm broad; 5-7 fibulae in 10 µm; 10-15 striae in 10 µm.
Occurrence: Rodríguez stream (D2, S2; D3, S3; D6, S1), Samborombón river (D4, S1, S2), El Gato stream (D6, S2).
Frequency: Frequent species.
Environmental requirements: In slighty saline waters (Hustedt 1930). Marine species, euhalobous to mesohalobous and euryhalobous (Lowe 1974). This species was found in Winter, Spring and Summer, in systems with a wide range of pH, conductivity, oxygen, suspended solids and nutrients concentrations. The maximum conductivity value was registered in Samborombón river, specially due to $Na^+$ and $Cl^-$ ions concentrations.

*Nitzschia* Hassall

*Nitzschia angustata* (W. Sm.) Grun.
Pl. II, fig. 12
Dimensions: 50-68 µm long.; 9-12 µm broad; 12-15 striae in 10 µm.
Occurrence: El Gato stream (D7, S5).
Frequency: Rare species.
Environmental requirements: In freshwaters, it is a frequent and widespread species (Hustedt 1930). Alkaliphilous (pH 6,4-8,5), saproxenous and limnophilous species (Lowe 1974). Species ocassionally present in freshwater, in reservoirs (Germain 1981). Ubiquitous species, diffuse and even rare (CEMAGREF 1999). This species was found in Spring, in the mouth of El Gato stream, a site with a pH of 7,6; low oxygen concentration and high conductivity (specially due to $HCO_3^-$, $Na^+$ and $Cl^-$) and high nutrients concentrations.
Observation: Fibules are indistinct, they probably coincide with stries.

*Nitzschia amphiboides* Hust.
Pl. II, fig. 13
Dimensions: 10-30 µm long.; 4.0-6.5 µm broad; 5-7 fibulae in 10 µm; 12-13 striae in 10 µm.
Occurrence: J. Blanco stream (D3, S3), El Pescado stream (D3, S2), Rodríguez stream (D1, S3), El Gato stream (D3, S3), Samborombón river (D3, S1).
Frequency: Frequent species.
Environmental requirements: Widespread species (Krammer & Lange-Bertalot 1988). This species was found in Fall and Spring, in systems with a wide range of pH, conductivity, nutrients, macroions and oxygen concentrations.

*Nitzschia clausii* Hantzsch.
Pl. II, fig. 14
Dimensions: 30-40 µm long.; 3-6 µm broad; 10-11 fibulae in 10 µm; 38-40 striae in 10 µm.
Occurrence: Rodríguez stream (D6; S1, S3), El Gato stream (D7, S5).
Frequency: Rare species.
Environmental requirements: Periphytic, alkaliphilous to indifferent species (pH 6,8-8,2); mesohalobous to indifferent; rheophilous to indifferent (Lowe 1974). In slighty saline waters and freshwater (Hustedt 1930). Brackish-water species, ocassionally found in freshwater (Germain 1981). This species was found in Winter, in Rodríguez stream, during a rainy period, and in Spring, in El Gato stream, during a dry phase; these sites registered a wide range of conductivity (specially due to $HCO_3^-$, $Na^+$ and $Cl^-$), suspended solids, nutrients, macroions and oxygen concentrations.

*Nitzschia terrestris* (Petersen) Hust.
Pl. II, fig. 15
Dimensions: 40-70 µm long.; 3-5 µm broad; 6-8 fibulae in 10 µm; 32-34 striae in 10 µm.
Occurrence: El Gato stream (D7, S5).
Frequency: Rare species.
Environmental requirements: This species was found in Spring, in the mouth of El Gato stream, a site with low oxygen and suspended solids concentration and high conductivity (specially due to $HCO_3^-$, $Na^+$ and $Cl^-$) and high nutrient concentrations.

*Nitzschia filiformis* v. *conferta* (Richter) Lange-Bertalot
Pl. II, fig. 16
Dimensions: 35-50 µm long.; 3-5 µm broad; 8-9 fibulae in 10 µm; 30-33 striae in 10 µm.
Occurrence: Rodríguez stream (D2, S1), J. Blanco stream (D5, S2), El Gato stream (D7, S5).
Frequency: Rare species.
Environmental requirements: In slighty saline waters;

pollution-tolerant species (Krammer & Lange-Bertalot 1988). This species was found in Fall, Winter and Spring, in systems with a wide range of pH, conductivity (specially due to $HCO_3^-$, $Na^+$ and $Cl^-$), suspended solids, nutrients and oxygen concentrations.

***Nitzschia obtusa*** W. Smith
Pl. II, fig. 17
Dimensions: 150-175 µm long.; 8-12 µm broad; 5-6 fibulae in 10 µm; 25-27 striae in 10 µm.
Occurrence: Samborombón river (D3, S3)
Frequency: Rare species.
Environmental requirements: It is considered a marine species which is registered too in brackish waters and in Sphagnum bogs (Germain 1981). Saline water species (Hustedt 1930). This species was found in Spring, in the mouth of Samborombón river, a site which registered a high pH (8.9), high conductivity (specially due to $Na^+$ and $Cl^-$), suspended solids and $NH_4^+$ concentrations.

***Nitzschia heufleriana*** Grun.
Pl. II, fig. 18
Dimensions: 70-125 µm long.; 3-5 µm broad;10-11 fibulae in 10 µm; 20-22 striae in 10 µm.
Occurrence: El Gato stream (D7, S2).
Frequency: Rare species.
Environmental requirements: Alkaliphilous species (Lowe 1974). Rare species (Hustedt 1930). Non frequent species which is considered a test of slight pollution; epilithic species in streams (Germain 1981). This species was found in Spring, in S2 from El Gato stream, a site with a high pH (8.4), high conductivity (specially due to $HCO_3^-$, $Na^+$ and $Cl^-$), high nutrients concentrations and low suspended solids concentrations.

***Nitzschia spectabilis*** (Ehr.) Ralfs
Pl. II, fig. 19
Dimensions: 170-260 µm long.; 10-13 µm broad; 5-6 fibulae in 10 µm; 11 striae in 10 µm.
Occurrence: Samborombón river (D4, S3).
Frequency: Rare species.
Environmental requirements: In slighty saline waters, widespread species (Hustedt 1930). This species was found in Summer, in the mouth of Samborombón river, a site with basic pH (8.3), high conductivity (specially due to $Na^+$, $SO_4^-$ and $Cl^-$), high suspended solids and $NH_4^+$ coancentrations.

## DISCUSSION

Although rare within the phytoplankton of freshwater lotic systems, the 37 % of the new record algae were marine, brackish or saline taxa; the environmental requirements of these species and other marine taxa cited in Mercado (2001) coincided with the high conductivity values registered in the studied rivers and streams, except for Paraná de las Palmas river. These values fluctuated in each water body depending on their soil composition, the influence of mineralized ground water in streams surrounding La Plata city or the pollution due to industrial activities (Mercado 1999, 2000, 2000a). Samborombón river registered high conductivity values in its middle and lower course because of the small gradient (0.13 m $km^{-1}$) and low altitude that allowed the formation of swamps, in which a layer of groudwaters emerges (Mercado 1999, 2000a). In S3 of Pescado, Buñirrigo streams and in Samborombón river, brackish and marine diatoms appeared because of Río de la Plata tides influence, which increase conductivity due to salinity gradients.

The presence of certain pollution-tolerance species such as Navicula goeppertiana, Nitzschia heufleriana and N. filiformis v. conferta, and other algae cited in Mercado (2001) is due to the high nutrient concentrations registered specially in El Gato stream and in the middle and lower sections of Rodríguez stream; agricultural and industrial activities developed in their margins, along with man settlements, produce an important anthropogenic impact on them (Mercado 1999, 2000a, 2000b, 2000c, 2000d). Nutrient concentration figures of the studied lotic systems exceed media values of unpolluted rivers cited by Meybeck (1982) and aquatic life protection values in AGOSBA-OSN-SIHN (1994) except for S1 of J. Blanco stream, which is situated in 'Parque Costero del Sur' UNESCO reservation (Mercado 1999, 2000, 2000a).

All the new record species were found in systems which belonged to the eutrophic type, according to Margalef (1983), as it is cited in Mercado & Gómez (1998b, 1999, 2000) and Mercado (2001), except for J. Blanco stream, which is considered a mesotrophic system (Mercado 2001).

The presence of tycoplanktonic species in the

phytoplankton of the studied systems, which emigrated from the epilithon, such as *Diploneis oculata* and *Nitzschia heufleriana,* and from the periphyton, such *as Nitzschia clausii*, and other algae cited in Mercado (2001), indicate interactions among those communities, specially in the shallow stretches; this situation was exposed by Whitton (1975).

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